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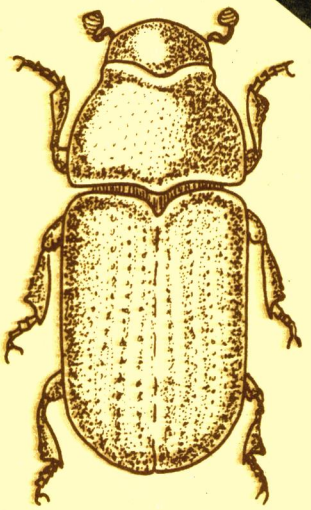
ANNUAL REPORT
Forest Disease Detection Survey: Air Pollution

Arizona and New Mexico
Region 3

1975



Southwestern Region

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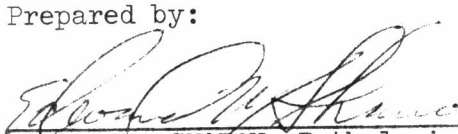
December 1975

Forest Insect and Disease Management
State and Private Forestry
Southwestern Region, Forest Service, USDA
517 Gold Avenue, SW
Albuquerque, New Mexico 87102

Prepared by:



EDWARD M. SHARON, Pathologist
Forest Insect and Disease Management

APPROVED BY:

DONALD P. GRAHAM, Director
Forest Insect and Disease Management

THOMAS G. SCHMECKPEPER
Deputy Regional Forester
State and Private Forestry

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
Region 3
517 Gold Avenue, SW
Albuquerque, New Mexico 87101

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To All Survey Cooperators and
Interested Individuals

The enclosed report, "Forest Disease Detection Survey: Air Pollution," is for your information. The report covers the results of our 1975 survey of Forests in Arizona and New Mexico for air pollution injury caused by sulfur dioxide.

The amount of injury detected in 1975 was slightly less than reported in 1973 (quantitative data were not collected in 1974 due to personnel change). Only two areas were affected and no tree mortality was observed.

Should you need additional information, or copies of this report, please write to:

Forest Insect and Disease Management
State and Private Forestry
Southwestern Region, Forest Service, USDA
517 Gold Avenue, SW
Albuquerque, New Mexico 87102

Sincerely,

Thomas G. Schmeckpeper

THOMAS G. SCHMECKPEPER
Deputy Regional Forester
State and Private Forestry

INTRODUCTION

In July 1970, an extensive air pollution detection survey network was established to determine if SO_2 and NO_x from existing major sources was causing injury to forest vegetation in New Mexico and Arizona. Twelve major sources of air pollution (copper smelters and electrical power plants) exist in the two States.

The detection network consisted of 82 vegetation plots and 60 sulfation plate stations on 24 survey areas. Selection criteria for "sensitive" observation plots were: (a) presence of a variety of vegetation and (b) adequate soil moisture and relatively high humidity (1). Symptoms of acute* injury were observed and assessed since a reliable method for identifying and/or assessing chronic** injury under field conditions has not been developed for forest vegetation in the Southwest. Plots were examined annually, July through September.

In 1973, the number of vegetation plots was reduced to 12 on 5 survey areas because results of previous examinations indicated few or no symptoms of SO_2 injury on forest vegetation. However, symptoms of acute SO_2 injury were observed on minor forest vegetation on three National Forests in Arizona: Apache-Sitgreaves near Morenci, Coronado near San Manuel, and Tonto near Miami (2). Two vegetation plots were established for the first time on the Petrified Forest National Park in 1973 in anticipation of increased SO_2 emissions from Joseph City power plant, and an additional plot was established on the Apache-Sitgreaves National Forest (Table 1).

METHODS

All plots listed in Table 1, except those on the Tonto National Forest, were examined during July 1975. Plots on the Tonto National Forest were examined in September. Symptoms of SO_2 injury were interveinal bleaching, browning and necrotic areas on broadleaf plants, and tip dieback and banding on needle-leave species. Several symptoms of abnormal plant physiology resemble SO_2 injury; therefore, injury observed on individual plants was not attributed to SO_2 unless similar injury was observed on one or more plant species known to be sensitive to SO_2, such as brickelbush, skunkbush, globe mallow, sacred datura, etc. For each species examined, the following were determined

*Expressed as interveinal bleaching, browning, and bifacial necrosis on broadleaf plants, and tip dieback and banding on needle-leaved plants.
**Expressed as premature senescence, incipient necrosis, and reduced growth.

visually: (a) mean percent of foliage affected, (b) mean percent of leaf area affected, and (c) percentage of plants with SO_2 injury based on total number of plants examined within the species.

Results of the 1975 survey are presented and evaluated in this report.

RESULTS

Neither killed nor declining trees were observed on any of the 15 vegetation plots examined. Needle flecking on ponderosa pine was observed again this year. This symptom has been observed both near and far from SO_2 sources. Its cause is uncertain. Several plant species on the Tonto National Forest (plot 6) and Apache-Sitgreaves National Forest (plot 5) had injury associated with SO_2 (Tables 3 and 4).

Tonto National Forest, Globe Ranger District, Plot 6

The observation plot is located approximately 4 miles from the copper smelter near Miami, Arizona. Intercostal bleaching, browning, and/or necrotic areas were observed on several broad-leaved species: brickelbush, skunkbush, and Arizona sycamore; SO_2 injury has been observed on these species each year since 1971.* Injury on canyon grape, first reported in 1973, occurred again in 1975.* Only two ponderosa pines had needle tip dieback (Table 3).

Apache-Sitgreaves National Forest, Clifton Ranger District, Plot 5

The observation plot is located approximately 8 miles from the copper smelter at Morenci, Arizona. Intercostal bleaching, browning, and/or necrotic areas were observed on: brickelbush and skunkbush; SO_2 injury has been observed on these species each year since 1971.* Injury on Arizona white oak, Arizona sycamore, and sacred datura, first reported in 1973, occurred again in 1975.* Tip dieback was observed on two Mexican pinyon (Table 4).

Other Observation Areas

Petrified Forest National Park, plots 1 and 5; Fort Bayard Hospital; Gila National Forest, Silver City Ranger District, plot 7; Coronado National Forest, Santa Catalina Ranger District, plots 1 and 6; Apache-Sitgreaves National Forest, Clifton Ranger District, plot 2; Tonto National Forest, Globe Ranger District, plots 4, 5, 7, and 10.

*Data are not available for 1974 due to personnel change.

Injury typical of SO_2 fumigation was not observed on vegetation examined in these areas (Table 2). However, symptoms such as marginal chlorosis, chlorotic mottle, shot hole, and necrotic lesions on broadleaf species commonly occurred on some vegetation.

DISCUSSION

Results of this survey indicate that acute SO_2 injury to forest vegetation was slightly less than reported in 1973; fewer species and plants per species were injured on plot 5 (Apache-Sitgreaves National Forest) and plot 6 (Tonto National Forest). SO_2 injury has been observed on these plots since 1971. On the Coronado National Forest (plot 6), the only species reported injured in 1973 (brickelbush and conyza) had no symptoms of SO_2 injury in 1975. The decrease in acute SO_2 injury is probably a result of decreased production by the copper industry; the industry is presently in a slump and an increase in production at this time is not anticipated (3).

As in previous years, no plots had trees that were being killed as a result of SO_2 fumigation; and aerial observation indicated trees were not killed in the general area of plot 5 (Apache-Sitgreaves National Forest) and plot 6 (Tonto National Forest). Aerial observation was not made of: Petrified Forest National Park, Fort Bayard, Gila National Forest, and Coronado National Forest because on-the-ground examination of the vegetation plots did not reveal SO_2 injured plants.

The 1975 survey and previous Regionwide examinations of air pollution vegetation plots have not revealed symptoms of acute SO_2 injury to forest plants at distances greater than approximately 8 miles from a SO_2 point source (1); forest trees have not been killed as a result of SO_2 fumigation in any area examined, and SO_2 injury has been limited primarily to minor perennial plants.

On the basis of the above information, it is recommended that future surveys of forest lands in the vicinity of smelters at Morenci, Miami, and San Manuel, Arizona, be aerial. Prominent areas of discolored foliage and/or fading trees should be looked for within approximately a 10-mile radius of a point pollution source; when discovered, such areas should be ground checked for sensitive indicator plants and supporting evidence of SO_2 fumigation.

Brickelbush, willow, skunkbush, sunflower, and cocklebur are sensitive indicator plants of SO_2 fumigation; they are injured by SO_2 concentrations that are approximately 2 to 3 times less than SO_2 concentrations

that injure foliage of ponderosa pine, Douglas-fir, and pinyon (4). These plants are common to the Southwest. Whenever SO_2 injury to major forest vegetation is suspected, the land manager should examine the area for plants known to be sensitive to SO_2;* when more than one of these is affected, it is probable that injury on other plant species is associated with SO_2 fumigation. It is important that several species of plants be examined and similar symptoms associated with SO_2 fumigation are observed, since several symptoms of abnormal plant physiology resemble SO_2 injury.

Collection of base line ground information of air pollution injury to forest vegetation should be continued in areas that may be affected by new point sources of air pollution that may be operable 1 to 5 years from now.

REFERENCES

(1) Loomis, R. C. 1973. Disease detection survey, air pollution, Arizona and New Mexico, Region 3, R-3 73-24. USDA, Forest Serv., Reg. 3, Div. of Timber Management. 118 p. (Unpublished office report).

(2) Weiss, M. J. 1974. Annual report, forest disease detection survey: air pollution, Arizona and New Mexico, Region 3, R-3 74-24. USDA, Forest Serv., Reg. 3, Div. of Timber Management. 26 p. (Unpublished office report).

(3) The Arizona Republic, Oct. 22, 1975.

(4) Caldwell, R. L. 1974. Relative sensitivity of select southwestern native vegetation to sulfur dioxide. Progress report, 4th quarter. (Unpublished).

*Cooperative study with University of Arizona to determine relative susceptibility of selected southwestern plants to SO_2 will be completed in 1975. Plant list and ranking will be in 1976 annual report.

A P P E N D I X

1. Table 1, Observation plots examined in 1975.
2. Table 2, Summary of all plots.
3. Table 3, Summary of data from observation plot 6, Globe Ranger District, Tonto National Forest, 1975.
4. Table 4, Summary of data from observation plot 5, Clifton Ranger District, Apache-Sitgreaves National Forest, 1975.

Table 1.--Observation plots examined in 1975.

Administrative unit	Vegetation observation plot No.	State	County	Legal description	Aprx. elev. (ft)	Direction from nearest source	Aprx. dist. from nearest source (miles)	Est. size of observation plot (acres)	Month exam.
Gila NF, Silver City RD	7	N.M.	Grant	T16S,R13W,S30	6,600	NW	14.5	2	Jul.
Gila NF, Silver City RD	9	N.M.	Grant	T17S,R13W,S24	6,200	N	8.5	1	Jul.
Fort Bayard Hospital	1	N.M.	Grant	T17S,R13W, S25,26	6,100	N	7.0	1	Jul.
Coronado NF, Santa Catalina RD	1 (Peppersauce) Campground)	Ariz.	Pinal	T10S,R16E,S28	4,600	SW	7.5	3	Jul.
Coronado NF, Santa Catalina RD	6 (Peppersauce Cave - Tule Spring)	Ariz.	Pinal	T10S,R16E, S33,34	4,700	SW	8.0	1	Jul.
Tonto NF, Globe RD	4	Ariz.	Gila	T1S,R15E,S27	4,800	S	7.5	1	Sep.
Tonto NF, Globe RD	5 (Pioneer Pass Campground)	Ariz.	Gila	T2S,R15E,S3	5,800	S	9.5	1	Sep.
Tonto NF, Globe RD	6 (Warnica Springs Picnic Area)	Ariz.	Gila	T1S,R14E,S12	5,000	SW	4.0	2	Sep.
Tonto NF, Globe RD	7	Ariz.	Gila	T1S,R15E,S30	5,200	S	6.5	1	Sep.
Tonto NF, Globe RD	10 (Kellner Campground)	Ariz.	Gila	T1S,R15E,S20	4,500	S	5.5	2	Sep.

Table 1.--Observation plots examined in 1975 (continued).

Administrative unit	Vegetation observation plot No.	State	County	Legal description	Aprx. elev. (ft)	Direction from nearest source	Aprx. dist. from nearest source (miles)	Est. size of observation plot (acres)	Month exam.
Apache-Sitgreaves NF, Clifton RD	2 (Granville Rec. Area)	Ariz.	Green-lee	T3S,R29E,S8	6,700	N	8.5	2	Jul.
Apache-Sitgreaves NF, Clifton RD	2A	Ariz.	Green-lee	T3S,R29E,S16	6,100	N	7.5	1	Jul.
Apache-Sitgreaves NF, Clifton RD	5 (Coronado Spring)	Ariz.	Green-lee	T3S,R29E,S16	5,600	N	7.0	2	Jul.
Petrified Forest NP	1 (Admin. Site)	Ariz.	Apache	T19N,R24E,S10	5,500	E	30.0	2	Jul.
Petrified Forest NP	2	Ariz.	Apache	T18N,R24E, S4,9	5,500	E	28.5	1	Jul.

Table 2.--Summary of all plots.

Plant	Number examined												
	Gila NF	Fort	Coronado NF		Tonto NF					Apache-Sitgreaves NF		Petrified Forest NP	
	#7	Bayard	#1	#6	#4	#5	#7	#6	#10	#2	#5	#1	#5
Arizona alder	4								6				
Arizona cypress											4		
Arizona sycamore			10		8			8*	5		5*	2	
Arizona walnut	3		5	2	3	8			4	6	4		
Arizona white oak			7	1	7		3	7	5		6*		
Beardtongue							2						
Bee-balm					2	3		1	5				
Brickellia	6		15	15	14	10	23	7*	19	14	10*		
Canyon grape	4	4	8	4	8	4	1	5*	4	3	5		
Catclaw acacia			7		1			3	3				
Common chokecherry			1			8							
Conyza			5										
Cranesbill						5							
Flowering crab apple												2	
Four-winged saltbush												6	11
Fremont cottonwood									5			7	11
Gambel oak										7			
Ginkgo												1	
Globe mallow	11	6				12	2			2		6	
Goldenrod					12				4				
Gray oak	1												
Hackberry			6	3									
Hollyleaf buckthorn					4		4	5					
Lanceleaf cottonwood		8										1	
Meadow rue										5			
Mexican pinyon											2*		
Mullein	11												
Netleaf oak											5		
New Mexican locust					5	5				6	6		

*Indicates plants with SO_2 associated injury.

Table 2.--Summary of all plots (continued).

Plant	Number examined												
	Gila NF	Fort	Coronado NF		Tonto NF					Apache-Sitgreaves NF		Petrified Forest NP	
	#7	Bayard	#1	#6	#4	#5	#7	#6	#10	#2	#5	#1	#5
Pigeonberry			7										
Pinyon	5											3	
Pointleaf manzanita											4		
Ponderosa pine	9					10	13	8*		7			
Rose										5			
Russian olive												7	
Sacred datura											2*		
Scarlet sumac	8									3	12*		
Scorpionweed											2		
Seepwillow											3		
Silverleaf oak										3	10		
Skunkbush		8		2	4			4*	9		5*	5	
Snowberry						3							
Southwestern chokecherry								2		4	1		
Sweet clover			5										
Texas honeylocust												4	
Toumey oak							5						
Willow	2			8				2					10

*Indicates plants with SO_2 associated injury.

Table 3 .--Summary of data from observation plot 6, Globe Ranger District, Tonto National Forest, 1975.

Broad-leaved species examined	No. plants examined	Intercostal necrotic areas			Herbarium specimen No.	Photo No.	Additional observations
		% plants affected	% leaves affected	% leaf area affected			
Brickellia	7	43	5-80	10-60		302	
Arizona sycamore	8	100	50-90	5-20			
Skunkbush	4	25	30-40	10-50		306	
Canyon grape	5	100	75-90	10-60		304	
Bee-balm	1	0	0	0		305	
Willow	2	0	0	0			
Southwestern chokecherry	2	0	0	0			
Hollyleaf buckthorn	5	0	0	0		303	
Arizona white oak	7	0	0	0			
Catclaw acacia	3	0	0	0			

Needle-leaved species examined	No. plants examined	% plants with needle-tip dieback	% plants with needle banding	Age of needles affected	Needle retention	Herbarium specimen No.	Photo No.	Additional observations
Ponderosa pine	8	25	0	1- & 2-year	Normal			

Table 4 .--Summary of data from observation plot 5, Clifton Ranger District, Apache-Sitgreaves National Forest, 1975.

Broad-leaved species examined	No. plants examined	Intercostal necrotic areas			Herbarium specimen No.	Photo No.	Additional observations
		% plants affected	% leaves affected	% leaf area affected			
Brickellia	10	70	40-50	5-50		75-1, 4	
Arizona walnut	4	0	0	0			
Arizona white oak	6	20	50-90	10-90			
Seepwillow	3	0	0	0			
Silverleaf oak	10	0	0	0			Shot hole; some insect miner activity
Skunkbush	5	60	10-30	5-10		75-2, 3	
Southwestern chokecherry	1	0	0	0			
Scarlet sumac	12	25	50	5-20		75-5, 6	Scattered necrotic lesions Abundant flecking
Pointleaf manzanita	4	0	0	0			
New Mexican locust	6	0	0	0			
Canyon grape	5	0	0	0		75-11	
Arizona sycamore	5	100	40-60	5-30		75-8, 9	Insect activity suspected
Sacred datura	2	100	100	5-30		75-12	
Scorpionweed	2	0	0	0			Tip necrosis on oldest leaves
Netleaf oak	5	0	0	0			

Needle-leaved species examined	No. plants examined	% plants with needle-tip dieback	% plants with needle banding	Age of needles affected	Needle retention	Herbarium specimen No.	Photo No.	Additional observations
Mexican pinyon	2	100	0	2 years	Normal		75-7	
Arizona cypress	4	0	0					